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Behavioral Approaches For Limiting Depredation by Wild Ungulates

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Abstract

Wild ungulate foraging activities often negatively impact desirable resources, particularly where animal population densities are high. Agricultural crops suffer economic damage and natural ecosystems are altered. Various approaches to alter foraging behaviors are presented. Successful manipulation usually involves restricting ungulates access to a resource, encouraging animals to avoid an area, altering resource availability, or by reducing the desirability of the resource. Exclosures are probably the most effective means to reduce depredations. Ungulates also avoid areas that appear threatening. Habitat modification to reduce damage generally requires a reduction in resources to encourage animals to move out of an area, or an increase in resources to limit the use of the planted crop. Repellents are applied to plants to render the plant less attractive to foraging animals.

Why Manipulate Wild Ungulate Behavior

Wild ungulates (e.g., *Odocoileus* spp., *Cervus* spp.) occur across the United States and provide many desirable recreational and aesthetic opportunities. People generally enjoy watching these native species exhibiting their "natural" behaviors. Why then would anyone want to alter wild ungulate behaviors? Unfortunately, their foraging activities, particularly where population densities are high, often negatively impact desirable resources. These resources range from a homeowner's ornamental shrubs to valuable agricultural crops to native plant communities.

Deer and Elk damage a variety of grain crops, forage crops, vegetables, fruit trees, nursery trees, and ornamentals (Craven and Hygnstrom 1994). Beyond the immediate browsing damage, there are often residual damages, such as future yield reductions or growth deformities. Expanding ungulate populations are also a widespread detriment to reforestation efforts in the Pacific Northwest (Rochelle 1992). Ungulate browsing causes growth suppression and regeneration delays, as well as mortality among seedlings that are repeatedly browsed or pulled out of the ground (Crouch 1976, Tilghman 1989).

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Wild ungulates also thwart efforts to improve habitat quality. Considerable resources are currently being expended to establish native plants to increase forest diversity, improve riparian areas, re-vegetate disturbed sites, restore endangered or threatened plants, or to create wildlife habitat. Ungulates can be extremely detrimental to a project, particularly if animals make use of the plantings before the seedlings are well established or if use is severe. Interspersed western red-cedar (*Thuja plicata*) can add diversity to a forest stand or, when encountered by wildlife soon after planting, add diversity to an animal's diet. Habitat projects targeted to provide wildlife cover in ten years can be quickly converted to a meal supplement by a herd of migratory elk.

Natural ecosystems are being altered by high populations of ungulates (Stromayer and Warren 1997). Over browsing by herbivores can severely reduce seed production, plant establishment, and plant vigor and survival (Case and Kauffman 1997). Deer browsing has significantly impacted wildlife habitat in some northeastern forests by inhibiting the regeneration of stands or by altering tree species composition of regenerating stands (Curtis and Rushmore 1958, Brehand et al. 1970, Horsley and Marquis 1983). Under-story habitat changes have affected the presence of some bird species (DeGraaf et al. 1991). Wild ungulates have delayed the recovery of some riparian species following the removal of cattle (Case and Kaufman 1997). Ungulates also are reported to be responsible for changing forest regeneration in Europe (Motta 1996, Ammer 1996). There is an increasing concern regarding the impact of expanding deer populations on British woodland vegetation (Mitchell and Kirby 1990, Ratcliffe 1992, Kay 1993), and the concurrent indirect influences on invertebrates (Pollard and Cooke 1994). Habitat responses to grazing and browsing pressures also directly and indirectly affect other vertebrates and the future survival of ungulates themselves (Putman 1996).

Given these potential problems, resource managers may consider manipulating ungulate behavior to reduce depredation losses. Various approaches to alter behaviors are presented in this paper.

Manipulating Behaviors

Problems induced by ungulates are invariably linked to foraging activities. Understanding "normal" activities, physical restrictions, and the ontogeny of dietary behaviors is beneficial when trying to alter problematic behaviors. The literature on wildlife is replete with observations of dietary activities and, to a lesser extent, the physical requirements and nutritional needs of wild animals. The ontogeny of dietary behaviors is reviewed by Provenza et al. (1998), Provenza and Launchbaugh (this volume) and others in this symposium.

Mechanisms governing the foraging behavior of wild ungulates are most likely similar to those of domestic ungulates. Deer acquire the anticipated responses when submitted to classical (Henke 1997) or operant (Pollard et al. 1994) conditioning (McSweeney this volume). Prior foraging experiences influence the food selection and searching behavior of deer (Gillingham and Bunnell 1989), and the initial dietary behavior of ungulate offspring can be learned from their mothers (Edwards 1976). Alternatively, Spalinger et al. (1997) suggest that food selection by white-tailed deer (*Odocoileus virginianus leucurus*) is largely an innate behavior, and that social learning would be maladaptive or detrimental to the animal. Instead of social learning, herbivores should rely on mechanisms that enhance gustatory or olfactory detection that permits an evaluation of forage quality (Spalinger et al. 1997). Regardless, wild ungulates have demonstrated a plasticity in their dietary behaviors which permits them to adapt to environmental conditions; a necessary requirement for behavior manipulation to be possible.

Training individual wild ungulates to avoid a particular food is rarely practical. Rather, the manipulation usually involves restricting ungulate access to a resource, encouraging the animal to avoid an area, altering resource availability, or by reducing the desirability of the resource. Operational success depends largely on selecting approaches which encourage behaviors within an individual's repertoire and which do not necessitate sacrifices that threaten survival. In other words, do not require the subject to fly unless it has wings, and do not set management objectives which require suicidal tendencies from animals.

Excluding Ungulates

Exclosures are probably the most effective means to reduce depredation by ungulates (Palmer et al. 1985). Where ungulates are abundant or crops are particularly valuable, fencing may be the only way to effectively minimize damage (Craven and Hygnstrom 1994). Permanent structures are expensive and require maintenance (Caslick and Decker 1979). Temporary fences are less costly and can be moved as necessary, but they are generally less effective. Individual plant barriers are more economical and can be effective under the proper conditions.

Fences to keep out elk and deer should be a minimum of 8 feet and preferably 10 feet tall. Woven wires (Fig. 1a) are much more effective at deterring ungulates than are strands of smooth or barbed wire (Fig. 1b). Strands of wire installed immediately above woven wire provide additional height. An electrified fence is more effective than a similar non-electrified fence. Building a double or slanted fence adds depth making the fence more difficult for ungulates to jump over (Fig. 2a,b). Flagging should be attached to all wire fences to increase their visibility to animals.

Animal movements can be hampered by exclosures. When possible a series of small intermittent exclosures (30 x 30-feet) may be more effective than an extended barrier. The smaller exclosures do not block access to resources or impede the migratory movements of animals as severely as the large exclosures. Once the resource matures and becomes less vulnerable to damage, the small exclosures are then moved to adjacent areas.

Netting can be used to construct temporary exclosures. The light weight of netting does not require as durable or as strong a support as those needed for conventional fences. Netting strung between metal fence posts creates a barrier for deer and elk. Small plants or seed-beds can be protected by draping netting over supports to create tent-like structures. A series of inverted U's constructed out of plastic pipe also works well to support nets.

A baited electrified wire can encourage deer to avoid an area. Deer are enticed to lick peanut butter from the wire, and a shock is delivered on contact (Fig. 3). This method can be effective to protect small patches in areas with few animals. I have conditioned black-tailed deer (*Odocoileus hemionus columbianus*) to avoid flagging

Figure 1. Diagram depicting a (a) woven-wire fence and a (b) and a seven-wire vertical fence built to exclude ungulates (Craven and Hygnstrom 1994).

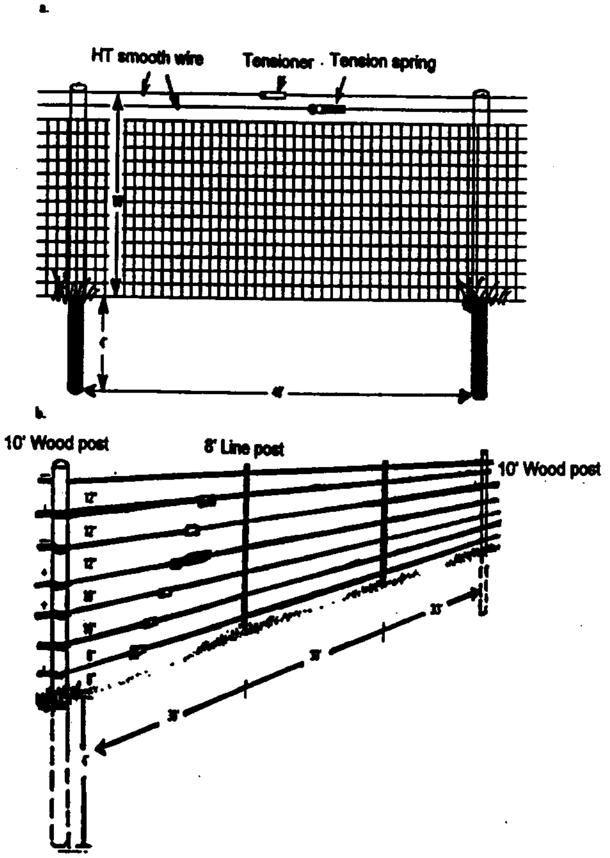
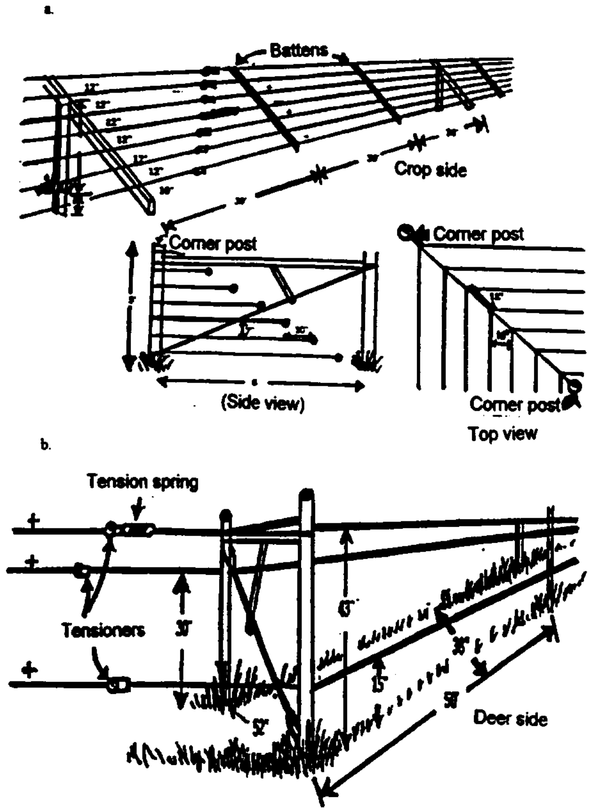


Figure 2. Diagram depicting a (a) slanted seven-wire deer fence and a (b) offset or double fence built to exclude ungulates (Craven and Hygnstrom 1994).



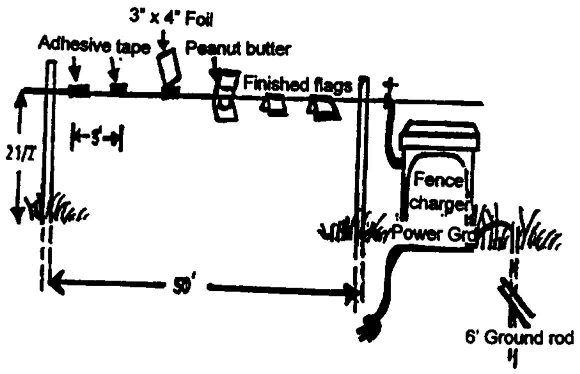
in a similar manner (unpublished data). During training, wires covered in flagging were hung around suspended apples. Other apples were suspended in wires without flagging. Deer then received a mild shock as they attempted to mouth apples associated with flagging. These animals soon avoided flag covered apples. The conditioning to avoid flags temporarily persisted in some animals and avoidance was generalized to other protected resources, such as flag draped seedlings.

Individual barriers also can be placed around seedlings or portions of their stems or foliage. Often tree seedlings will survive if their terminal bud is protected. A variety of products are commercially available or can be constructed from common materials (Marsh et al. 1990). When properly installed, individual barriers can protect most plants under moderate grazing pressure. They generally are not hazardous to wildlife and they do not impede wildlife access to other forage. Some barriers are relatively inexpensive and require minimum skill to apply, while others are quite expensive. Despite potential benefits, barriers come with a host of likely pitfalls. Increased humidity in some tubes may increase problems with foliar diseases. Improperly selected or poorly installed barriers can cause seedling deformities or increase seedling mortality. Brightly colored barriers also have been known to attract animals. Poorly staked barriers can be pushed over and though browsing is reduced the seedling is subsequently prevented from returning to an upright position. Conical protectors need to be removed as the seedlings grow or they will interfere with growth and cause deformities. Debris (e.g., branches) placed over seedlings can deter ungulates, but also provides protective cover for small mammals and may inadvertently increase damage by rodents.

Encouraging Avoidance

Ungulates avoid areas that appear threatening. What constitutes a threat, however, depends largely on the experience of the animal. Wild ungulates in remote areas are rarely seen unless noise and movement is kept to

Figure 3. Diagram depicting a "peanut butter" fence. Deer receive a mild shock when they contact the fence to eat the peanut butter and learn to avoid the area. (Craven and Hygnstrom 1994).



a minimum, while urban deer may munch on roses adjacent to a house with an open window and kids playing inside. Regardless, visual displays or noises that do alarm the animal will discourage its presence. Humans screaming and chasing wildlife was most likely the first historical attempt at animal damage prevention. Modern noisemakers are still used to scare animals away from resources. Visual displays, such as scarecrows, also are traditional means to alleviate depredation in gardens or small fields.

Animals are generally wary of any unfamiliar sound or sight, but they become less wary with time unless the noise is paired with a negative reinforcer. Most frightening devices (e.g., artificial light, automatic exploders, pyrotechnics) rarely work for more than a few days or at most a week (Koehler et al. 1990). Familiarity of wildlife to devices can be minimized by installing or operating the devices only when resources are most susceptible to damage. Devices, however, need to be used immediately after the onset of damage. Established movements and behaviors are much more difficult to disrupt than are newly forming behavioral patterns. Efficacy of products can usually be increased by alternating techniques or use patterns. Sporadic displays or devices that are activated by an animal's presence are more effective than permanent or routine displays. Visual displays combined with noisemakers are generally more effective than either technique implemented alone. For example, sirens and strobe lights activated at irregular intervals are likely to be more effective than either a constant visual display or loud noises emitted at fixed intervals. Supplementing these techniques with occasional punitive measures also can increase their effectiveness. For example, elk on golf courses readily habituate to pyrotechnic devices, but when they are occasionally struck by rubber balls (scary but non-lethal) in conjunction with pyrotechnics, they quickly disperse from the fairways. Properly trained dogs confined within the boundaries of the resource to be protected also are very effective at deterring ungulates.

Most of the evidence that supports the use of frightening methods to reduce predation is anecdotal stories. Few devices have been well tested, particularly under field conditions. Ultrasonic, vibrating, and electromagnetic devices generally lack effectiveness and are of little practical value (Koehler et al. 1990, Shumake 1997). Warning whistles attached to vehicles have proven to be largely ineffective (Romin and Dalton 1992). Overall, frightening devices are most appropriate for use where a crop or situation needs protection for only a few days, such as just before harvest or from migratory elk (Koehler et al. 1990).

Altering Resource Availability

Habitat modification to reduce damage generally requires a reduction in resources to encourage animals to move out of an area, or an increase in resources to limit the use of the planted crop. Over time, animal populations may decline with a reduction in favorable habitat. However, if the protected resource is reestablished too soon after habitat depletion it will likely be a limited, and thus valuable, resource and probably be consumed. Another consideration is the fate of the displaced animal. Resource depletion may work well if the animal is transitory and can readily locate suitable alternatives. Individuals with few options, however, are less likely to re-locate successfully. Abrupt habitat changes for these species probably becomes lethal, and more humane methods should be considered if population reduction is the objective.

Providing wildlife with viable alternative foraging options can alleviate foraging pressure. Desirable foods can be distributed across problem areas or on adjacent sites to encourage animals to move away from the protected resource. For example, alfalfa distributed along migratory trails may encourage ungulates to quickly travel past vulnerable seedlings. On succeeding days food should be placed at increasingly further intervals from the protected resource. Another approach is to plant or encourage the establishment of natural forages preferred by wildlife species (Campbell and Evans 1978). Food supplement can also be provided in semi-permanent structures strategically placed adjacent to or within sites that are vulnerable to damage. The efficacy of supplemental feeding, however, is variable and the results are commonly dependent on weather conditions (Doenier et al. 1997). Often animals continue to forage between bouts at the feed stations (Schmitz 1990). Supplemental feeding to deter ungulate damage may not be economically feasible. Food plots are generally more cost effective than feeders, but even they are not economical for most agronomic crops (McBryde 1995).

Before implementing a feeding program to reduce damage, the long-term consequences need to be considered. Alternative forages can increase or prolong the presence of wildlife on selected sites. Increased resources may encourage additional animals to frequent the area, or an improved nutritional status may enhance reproductive success. Further, resource-dependent territorial boundaries may shrink with improved resource availability, which in turn permits more individuals to exist within a given area. Big game herds may suspend or delay migratory movements. A feeding program, therefore, might actually increase wildlife pressure on resources if the program is not sustained or fails to meet the increasing demands. A successful program needs to be specific in targeting a problem. In addition, a way to continue the program indefinitely or plans to wean the supplemented animal from the program need to be identified before a feeding program begins. The potential for animals to later revert to protected resources also needs to be anticipated and avoided.

Damage to ornamental plants can be minimized by selecting landscape and garden plants that are less desirable to deer (Craven and Hygnstrom 1994). Lists providing the relative vulnerability of many ornamental plants are available (Cummings et al. 1980, Conover and Kania 1988, Fargione et al. 1991). Though a damage free guarantee can not be assumed, the likeliness of damage to a plant rated highly palatable is considerably greater than a plant listed as seldom eaten.

Environmental conditions can impact the chemical composition of a plant which in turn changes its relative preference for animal consumption. For example, the susceptibility of Sitka spruce (*Picea sitchensis*) trees to red deer (*Cervus elaphus*) browsing varies with monoterpene concentrations (Duncan et al. 1994). Kimball et al. (1998a) determined the role of chemical constituents in Douglas-fir (*Pseudotsuga menziesii*) on the foraging behavior of black bears (*Ursus americanus*). Basically, bears preferred trees high in carbohydrates and low in sugars. Subsequently, they predicted the relative vulnerability of timber stands based on how silvicultural practices affected these chemical constituents. Damage levels are expected to be higher in thinned stands, and in fertilized stands the year after urea application (Kimball et al. 1998c). Pruning reduced plant sugars, thus rendering trees less vulnerable to bear foraging (Kimball et al. 1998b). Similar efforts need to be made with ungulates to provide managers the ability to at least predict the impact agricultural practices have on damage vulnerability. Kimball et al. (1999) also rated select tree genotypes to damage vulnerability. Surprisingly, some genotypes with demonstrated higher growth potential ranked lower for anticipated bear preference than genotypes with low growth potential; indicating that it may be possible to select for genotypes less vulnerable to animal damage without sacrificing growth potential.

Reducing Resource Desirability

An animal may select one food over another because it is attracted to the first or because it is avoiding the alternative (Galef 1985). Thus, the likelihood of a particular plant being eaten depends on its own palatability, and the availability and desirability of alternative foods. Repellents are applied to plants to make them less attractive to foraging animals. In theory, animals shift foraging to alternate plants or forage in areas that are not protected with repellents.

The avoidance of repellents by wildlife may be innate or acquired through a conditioned food aversion. Repellents that elicit initial avoidance are generally either irritants or those that evoke a "fear" response (Mason and Clark 1997). These stimuli require no prior encounters to cause avoidance behavior. Irritants stimulate trigeminal pain receptors in the mucous membranes of the eyes, mouth, nose and gut lining (Silver 1990). For mammals, including ungulates, strong irritants include capsaicin and capsicum oleo resins (Maga 1975), and volatile chemicals such as allyl isothiocyanate and ammonia (Budavari et al. 1989).

Fear-inducing repellents include sulfur compounds and volatile ammonium soaps of higher fatty acids (Milunas et al. 1994). Degrading animal waste products and most predator urine emit sulfurous odors. Several studies report BGR-P, active ingredient is fermented egg, to inhibit foraging by black-tailed deer (Melchoirs and Leslie 1985, Nolte et al. 1995, Nolte 1998), mule deer (*Odocoileus heminous*; Andelt et al. 1991, 1994), white-tailed deer (Dietz and Tigner 1968, Harris et al 1983, Palmer et al. 1983, Conover 1984, Swihart and Conover 1990, Milunas et al. 1994) and elk (*Cervus elaphus nelsoni*; Andelt et al. 1992). The aversive qualities of predator urine reflect the diet of the predator (Nolte et al. 1994a). Predator odors have been demonstrated to be avoided by several ungulates (Van Haaften 1963, Muller-Schwarze 1972, Melchoirs and Leslie 1985, Sullivan et al. 1985, Abbott et al. 1990, Swihart et al. 1991). Young black-tailed deer also spend less time foraging in areas contaminated with predator scats (Muller-Schwarze 1972).

Conditioned food aversions occur when ingestion of a novel food is paired with nausea or gastrointestinal distress (Garcia, 1989). Thus, any flavor paired with gastrointestinal distress can become an effective deterrent. Efficacy of repellents based on conditioned aversions, however, is generally limited because animals must be trained to avoid these materials. The use of conditioned-based repellents is especially problematic if the damage is inflicted by a transitory or migratory species (i.e., elk moving from summer to winter ranges). Further, the stimulus must be novel for animals to form a strong aversion. Damage inflicted to seedlings during training or subsequent sampling can be extensive.

Herbivores commonly ingest naturally occurring "bitter" compounds, and bitter substances that fail to induce gastrointestinal malaise are largely ineffective as repellents for herbivores (Nolte et al. 1994b). Several studies have reported bittering agents to be ineffective to deter browsing ungulates (Swihart and Conover 1990, Andelt et al. 1991, 1992, Nolte et al. 1995, Nolte 1998). An initial avoidance of these compounds probably reflects an unfamiliarity with the taste rather than an inherent aversion to the bitter taste. Animals commonly sample novel or unfamiliar foods cautiously (Rozin 1976). Herbivores, however, can detect bitter flavors and reliably acquire avoidance responses when these flavors are paired with gastrointestinal distress (Jacobs and Labows 1979). Red deer and roe deer (*Capreolus capreolus*) did differentiate between food altered with 1000 ppm denatonium benzoate and untreated food, and when offered a choice they restricted their intake of treated relative to untreated food (Wright and Milne 1996). These animals, however, did not restrict their daily intake when offered the treated food in a single-choice test.

A number of repellents are commercially available. Efficacy varies widely among them. Federal and State registrations certify that it is legal to use a product according to the conditions and restrictions stipulated on the approved label. At present, registration does not guarantee the availability or the efficacy of a product. A partial list of repellents marketed during 1998, and their respective active ingredient and delivery system is provided in Table 1. We recently tested a few of these to assess the efficacy to deter black-tailed deer browsing of western red-cedar (Table 2).

An effective program to reduce wildlife foraging through repellents depends on the relative desirability of the resource to be protected and the availability of alternative forage (Gillingham et al. 1987, Andelt et al. 1992). Preferred plants (e.g., western red-cedar) are more difficult to protect than less preferred plants, such as Douglas-fir (Nolte et al. 1995). An abundance of alternative forage permits animals to readily direct their consumptive behavior towards other plants. After treatment, an animal's foraging choices also depends on the size of the protected area relative to its territorial boundaries. Species with vague or extensive territories, such as deer, can more easily move to new areas to forage than can species with small and more rigid territorial boundaries (e.g., pocket gopher). Foraging pressure on protected plants also depends on the presence and densities of wildlife species. Competition among species may cause animals to be less selective. Likewise, high population densities may limit foraging alternatives, rendering repellents less effective.

Summary

Ungulates can pose problems for resource managers. The intensity or severity of impacts caused by wildlife will reflect the density of animals present, along with the existing habitat. Whether these impacts create a problem depends on the goals of a manager and the resources available to achieve these objectives. Assessing the potential for a problem is simple if there is a history of similar operations in the area. Merely verifying past successes and reasons for failed projects ought to be adequate. Projects being established in new areas will require some knowledge of the species and habitat present, and how the proposed operation will alter the dynamics of the current plant and animal interactions.

The most appropriate approach to reduce animal foraging needs to reflect the overall objectives of the manager, as well as the conditions of the specific problem. All techniques are not feasible or appropriate for all situations. No action may be the appropriate action if the problem is relatively minor. A few preliminary considerations will increase the success of a program. Check the legal ramifications for any action selected, and ascertain that the action will not be potentially hazardous to non-target species, in particular to endangered or threatened species. Public attitudes also need to be considered when selecting an approach. Develop a strategy to implement the selected approach. Though it may require time and effort, implementing the program should be straightforward. Unanticipated problems or concerns, however, may require modified or alternative strategies. Monitoring a damage reduction program is a necessity. Determine whether the desired goals are being achieved and whether there are any unexpected negative consequences. Continue to evaluate the program until the resource is no longer vulnerable, or conditions warrant terminating the program.

Table 1. List of products marketed during 1998 to deter deer browsing[1,2].

Product	Active Ingredient	Delivery System
Deer Away (BGR)	Egg	Topical spray
Deer Away (BGR-P)	Egg	Topical powder
Deer Off	Egg	Topical spray
Not Tonight Deer	Egg, Montok pepper	Topical spray
Mr. T's Deer Blocker	Egg, capsaicin, garlic	Topical spray
Deerbuster's Deer	Egg, capsaicin, garlic	Topical spray
Deerbuster's Deer	Egg, capsaicin, garlic	Topical powder
Deerbuster's Deer	Egg, capsaicin, garlic	Sachet
Dr. Deer	Garlic	Topical spray
Plant Pro-Tech	Garlic	Capsule
Hot Sauce	Capsaicin	Topical spray
Red Pepper Wax[3]	Capsaicin	Topical spray
Get Away	Capsaicin, allyl isothiocyanate	Topical spray
Green Shield	Capsaicin, allyl isothiocyanate	Topical spray
TKO Orange	d-limonene	Topical spray
C100	Coyote urine	Scent darts
Deerbuster's Coyote Urine	Coyote urine	Sachet
Wolfin[4]	Di (N-alkyl) sulfide	Capsule
Hinder	Ammonium soaps/higher fatty acids	Topical spray
Deerbuster's Deer and Rabbit	Ammonium soaps/higher fatty acids	Topical spray
Bye Deer	Sodium salts/mixed fatty acids	Sachet
Deer No No[5]	Sodium salts/mixed fatty acids	Sachet
Plantskydd	Bloodmeal	Topical spray
Deer Stopper[6]	Thiram	Topical spray
Shot-gun	Thiram	Topical spray
Ropel	Denatonium benzoate/thyomol	Topical spray
Repel[7]	Denatonium benzoate/thyomol	Topical spray
This 1 Works	Denatonium benzoate	Topical spray
Tree Guard	Denatonium benzoate	Topical spray

[1]Prepared by Kim Wagner.
[2]The use of trade names does not indicate endorsement of commercial products by the U.S. Department of Agriculture.
[3]Red Pepper Wax is advertised on the Internet as a deer repellent, but it is not labeled for use as a deer repellent.
[4]Wolfin is not currently registered for use in the United States.
[5]Deer Stopper was scheduled to be registered for use by the fall of 1998.
[6]Deer No No is advertised by the manufacturer on the Internet as containing specially formulated citrus scents, however, the label lists ammonium soaps of mixed fatty acids as the active ingredient.
[7]Repel also is advertised by Deerbuster's as a deer repellent, but this powder formula contains a different active ingredient and is not labelled as a foraging repellent.

Table 2. Average number of bites taken by black-tailed deer from western red-cedar seedlings at 2 and 12 weeks post treatment with select repellets[1] (unpublished data).

Repellent	2 Weeks	12 Weeks
Untreated	18.7 a[2]	25.0[3]a
TKO Orange	16.7 a	23.8 a
Wolfin	15.0 a,b	23.6 a
Ropel	14.9 a,b	25.0 a
Deerbuster's Deer and Insect	10.6 a,b,c	25.0 a
Hinder	10.4 a,b,c	25.0 a
Plant Pro-Tech	10.1 a,b,c	23.6 a
Hot Sauce	4.6 b,c	20.6 a,b
Tree Guard	3.8 b,c	15.9 a,b,c
Detour	3.4 b,c	23.5 a
N.I.M.B.Y.	1.7 c	16.5 a,b,c
Deer Away (BGR)	1.5 c	9.3 a,b,c
Get Away	1.4 c	6.4 b,c
Bye Deer	0.5 c	1.5 c
Coyote Urine Sachets	0.2 c	10.6 a,b,c
Not Tonight Deer	0.2 c	8.8 a,b,c
Plantskydd	0.1 c	4.2 b,c
Deer Stopper	0.1 c	10.5 a,b,c
Mr. T's Deerblocker	0.1 c	16.0 a,b,c
Deerbuster's Sachet	0.1 c	1.2 c
Deer Away (BGR-P)	0.02 c	0.04 c

[1]The use of trade names does not indicate endorsement of commercial products by the U.S. Department of Agriculture.
[2]Mean values within a column followed by the same letter are not significantly different $P > 0.05$.
[3]Completely defoliated seedlings were recorded as having had 25 bites.

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